



# 2014 GRID MODERNIZATION INDEX (GMI)



November 17, 2014



### **About GridWise Alliance**

The GridWise Alliance (GWA) is a coalition of electricity industry stakeholders that brings together electric utilities, industry suppliers, and service providers from the equipment, communications, and information technology sectors. Joined by universities, national laboratories and others, the GWA works to enhance electric grid performance, and to transform our nation's electric system to meet the needs of the 21<sup>st</sup> century.



### **About Smart Grid Policy Center**

The Smart Grid Policy Center (SGPC) is a not-for-profit foundation of public and private smart grid stakeholders who are aligned around a shared vision to transform and modernize the U.S. electric system.

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# 2014 Grid Modernization Index (GMI)

## EXECUTIVE SUMMARY

The United States (U.S.) electric system is undergoing a transformation unlike anything we have witnessed in the past 100 years. By the year 2030 or earlier, the grid will operate in a dramatically different way than it operates today, and interactions with the grid will change significantly as well. The rapid evolution of electricity supply and the increasing engagement of consumers, as producers/owners of distributed energy resources, has had major implications for the reliability, resiliency, and security of transmission and distribution grids. At the same time, our nation has an increasingly digital economy and is, therefore, even more dependent on affordable, secure, reliable, and resilient power.

Last year, the GridWise Alliance (GWA) and the Smart Grid Policy Center (SGPC) published a first-of-its-kind “Grid Modernization Index” (GMI) to rank and analyze the states and the District of Columbia, based upon the degree to which those jurisdictions have moved toward a modernized electric “Grid of the Future.” The GMI has been designed with the new requirements for the future grid in mind. For the U.S. to achieve a modernized grid that will support a sustainable energy future, changes to state and federal energy policies will be needed. In addition, a change in the business structure and operating mindset, in which electric grid utilities become service-oriented entities and not simply commodity suppliers, will be vital for this twenty-first century electricity system. Consumer engagement also will be increasingly crucial, as many customers become both energy consumers and producers (i.e., “prosumers”). And, grid-related investments will be needed not just for daily operations but for the increasing resiliency that our digital economy requires, including the capability to deal with extreme weather events and cyber and physical threats. These natural and human hazards now are part of our daily reality but were not considered when much of today’s electricity infrastructure was built.

In light of these challenges, GWA and SGPC are pleased to present this second annual GMI ranking of states, based on grid modernization policies, investments, and activities. This report also provides insights into some of the relationships and connections between state policies and regulations, customer engagement, and utility investments in the modernization of the grid.

The GMI ranking system, or “scorecard,” uses a clearly defined set of criteria to evaluate and convey the progress and impacts of this transformative set of improvements to the nation’s electric infrastructure. The GMI consists of three components:

1. **State Support:** State policies and regulatory mechanisms that facilitate grid investment;
2. **Customer Engagement:** Investments throughout the state in customer-enabling technologies and capabilities; and,
3. **Grid Operations:** Investments throughout the state in grid-enhancing technologies and capabilities.

Appendix A lists the survey questions used in the GMI.

## Key Developments:

2014 has been an active year for developing grid modernization state policies, investments, and activities. Some of the major state developments worth noting, include:

- California's efforts to address issues associated with an increasing penetration of both central and distributed renewable generation. These efforts include new requirements for utilities to develop plans for achieving new energy storage targets and developing distribution resource plan to accommodate a greater percentage of distributed energy resources (DERs).
- Texas continues to lead in the implementation of deregulated retail services and in effectively integrating large-scale wind generation including large-scale energy storage. ERCOT has an effort underway to "rethink" the entire existing set of ancillary services.
- Illinois' 2014 GMI ranking having increased by 13 points over its prior year's ranking clearly reflects the implementation of its "Energy Infrastructure and Modernization Act" passed in October 2011.
- Massachusetts deserves special recognition as a result of having created a Commonwealth-wide Grid Modernization Plan.
- New York's Public Service Commission initiated a State-wide Reforming the Energy Vision (REV) process in April 2014. This effort will have a significant impact on New York's grid modernization efforts but, perhaps even more significantly, is the way in which it might affect other states views on the role of the grid and the grid operator moving forward.
- Hawaii's Public Utilities Commission has also had an active year, focusing on achieving its energy goals. Increasing penetrations of rooftop solar have led to the need to focus on the modernization of the electric grid to be able to effectively integrate and utilize DERs.
- Overall, there is an increasing focus at the state level on DERs to enhance grid resiliency particularly in the Northeast where Hurricane Sandy had such a devastating impact in certain areas. States increasingly recognize that to effectively integrate DERs, the grid will have to be modernized.

## 2014 Leading State Scores:

This year's leading state scores are presented in Figure 1 below. For the 2014 GMI, all 50 states and the District of Columbia were evaluated. As was the case in 2013, the top two states for 2014 are Texas and California, with an overall score of 82. Illinois moved from tenth to third place with an overall score of 73. Pennsylvania, Maryland, Delaware, Nevada, the District of Columbia, Arizona, Virginia, Idaho (*not ranked in 2013*), Oklahoma, and Michigan round out the top 25 percent.

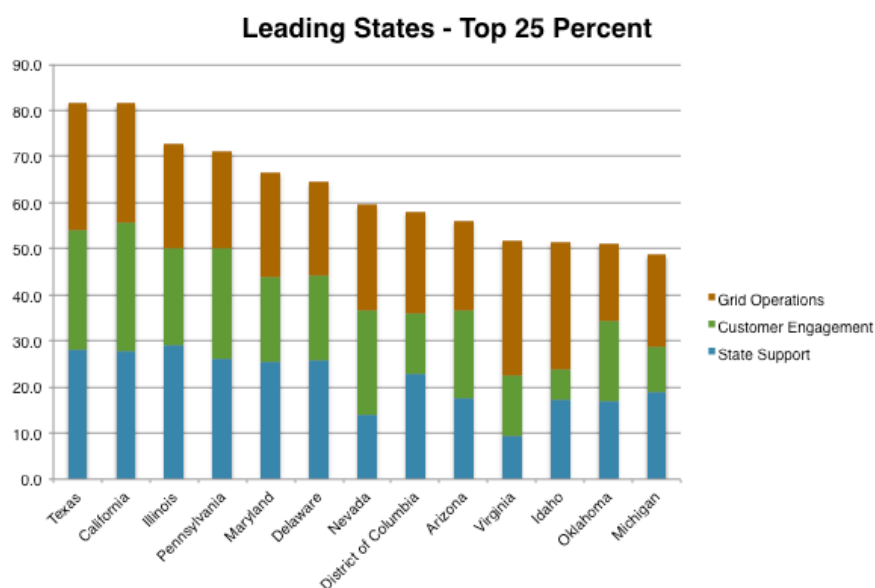


Figure 1 – 2014 GMI Leading State Rankings

### 2014 Highlights of Key Findings and Observations:

- Energy policies not directly targeted at Grid Modernization show statistically significant correlations to higher GMI scores in all three scoring components used herein, i.e., state support, customer engagement and grid operations. These state policies include:
  - Mandatory Renewable Portfolio Standards (RPS);
  - Energy Efficiency Resource Standards (EERS);
  - Retail Deregulation;
  - Wholesale Deregulation;
  - Independent System Operator (ISO)/Regional Transmission Operator (RTO) Markets; and,
  - Mass Market Demand Response Programs.
- The states that received federal Smart Grid Investment Grants have higher overall GMI scores, with the most significant impacts reflected in their Grid Operations scores.
- States with greater than 50 percent penetration of Advanced Metering Infrastructure (AMI) have higher average scores for all three scoring components.
- States with higher Gross Domestic Product (GDP) generally exhibit higher Customer Engagement scores as well as higher overall GMI scores.
- The Northeast Region has the highest average score, followed by the Western Region, Central Region and then the Southeastern Region.
- Higher penetration of DERs, particularly rooftop PV, is starting to drive an increasing urgency for grid modernization in order to enable the effective integration of these resources in many jurisdictions.



# 2014 Grid Modernization Index (GMI)

NOVEMBER 17, 2014

## INTRODUCTION

The United States (U.S.) electric system is undergoing a transformation unlike anything we have witnessed in the past 100 years. By the year 2030 or earlier, the grid will operate in a dramatically different way than it operates today, and interactions with the grid will change significantly, as well. The rapid evolution of electricity supply and the increasing engagement of consumers, as producers/owners of distributed energy resources, have had major implications for the reliability, resiliency, and security of transmission and distribution grids. At the same time, our nation has an increasingly digital economy and is, therefore, even more dependent on affordable, secure, reliable, and resilient power.

Regardless of the ultimate generation mix, the electric grid will play an increasingly critical role. In fact, it will be the essential enabling platform that supports this major transformation. The grid must be able to integrate increasingly diverse energy resources, including: central and decentralized generation, dispatchable and non-dispatchable generation, energy storage, and new controllable loads. Grid operators will have to balance supply and demand, not only at the transmission level, but also all the way down into the distribution grid. In some jurisdictions, consumers and third party providers will be able to participate in emerging retail markets, buying and selling services, potentially, not just with the grid operator, but, maybe even with each other. Consumers will have more choices and more control over how they meet their electric energy needs. For this future vision to become a reality, America's electric grid must be modernized with increasing intelligence and capabilities. It is vital to our national economy and security to ensure that our electric system is able to meet these increasingly complex requirements. This transformation of the electric grid will happen in different ways and at different speeds across the U.S., with some states moving more quickly than others. However, in a recent set of Regional Workshops conducted by the GridWise Alliance (GWA) in partnership with the U.S. Department of Energy's Office of Electricity Delivery and Energy Reliability (DOE-OE) on the "Future of the Grid," the results and expectations for the "Grid of the Future" were remarkably similar across all regions of the country.<sup>1</sup>

The grid must be able to effectively and efficiently integrate and manage new devices and systems, including customer-owned generation, connected appliances, smart buildings, energy storage, and electric vehicles, in support of a sustainable, reliable, and affordable energy future. Achieving these objectives will require situational awareness and controls all the way down to consumer interface points. In jurisdictions that permit the consumers to buy and sell services back to the grid, these transactions will need to be verifiable so that the grid operator, the services supplier, and the consumer all can be fairly compensated for the services provided. Most stakeholders agree that the meter will be a key component in enabling this new "transactive" relationship.

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<sup>1</sup> *The Future of the Grid* report can be downloaded at <http://www.gridwise.org>



This Grid Modernization Index (GMI) has been designed to assess the progress of the 50 states and the District of Columbia in developing these components and services of the future grid. For the U.S. to achieve a modernized grid, changes to state and federal energy policies will be needed. In addition, a change in business structure and operational mindset, in which utilities are service-oriented entities and not simply commodity suppliers, will be vital for this twenty-first century electricity system. Consumer engagement also will be increasingly crucial, as many customers become both energy consumers and producers (i.e., “prosumers”). And, grid-related investments will be needed not just for daily operations but for the increasing resiliency that our digital economy requires, including the capability to deal with extreme weather events and cyber and physical threats, which are now part of our daily reality but, which were not taken into account (or at least not adequately), when much of today’s electricity infrastructure was being built over the past century.

In light of these challenges, the GridWise Alliance (GWA) and the Smart Grid Policy Center (SGPC) are pleased to present this second annual ranking of the states, based on grid modernization policies and activities, entitled the “Grid Modernization Index” (GMI). The purpose of the GMI is to evaluate and communicate the status of electric grid modernization in the U.S. This report also provides insights into some of the relationships and connections between state policies and regulations, customer engagement, and utility investments in the modernization of the grid.

The GMI ranking system, or “scorecard,” uses a clearly defined set of criteria to evaluate and convey the progress and impacts of this transformative set of improvements to the nation’s electric infrastructure. This Grid Modernization Index consists of three components:

4. **State Support:** State policies and regulatory mechanisms that facilitate grid investment;
5. **Customer Engagement:** Investments throughout the state in customer-enabling technologies and capabilities; and,
6. **Grid Operations:** Investments throughout the state in grid-enhancing technologies and capabilities.

Appendix A lists the survey questions used in the 2014 GMI.

### Changes to the GMI from 2013

For 2014, minor changes to the GMI questions were incorporated to give credit to states for adopting industry standards for sharing energy usage data both with consumers and third party entities. In addition, two questions dealing with incentives and tariffs for Distributed Energy Resources (DERs) were changed to require electric vehicles (EVs) and energy storage to also be considered, as such.

The project team’s confidence level with regard to the accuracy of the rankings is higher this year than last, due to the acquisition of more data. The project team this year also actively engaged with an increasing number of state commissions and has incorporated their feedback into the state analyses and rankings.

This year, all 50 states and the District of Columbia have been evaluated. Each year the survey questions will be reviewed and updated to ensure they are appropriately capturing the investments and capabilities need to achieve this vision.

### Summary of Results:

2014 GMI scores and rankings are presented in Figure 2. The highest-scoring states for 2014 are Texas and California, as was the case in 2013, with an overall score of 82. Illinois moved from tenth to third place, with an overall score of 73. Pennsylvania, Maryland, Delaware, Nevada, the District of Columbia, Arizona, Virginia, Idaho (*not ranked in 2013*), Oklahoma, and Michigan comprise the next highest-ranking states.

Analysis of these “leading” (i.e., highest scoring) states demonstrates some commonalities, or common factors or policies, that exist and have been implemented by these states, that are also supported in the statistical analysis discussed later in this report. Table 1 below highlights these common factors for the top 25 percent ranked states.

State	RPS	EERS	AMI	ARRA Grant	Whole-sale Dereg.	Retail Choice	Other factors
Texas	Y	Y	67%	\$780M	Y	Y	Has leveraged AMI to enable the retail choice market – Texas Portal, enabled immediate switching
California	Y	Y	83%	\$521M	Y	N	Largest AMI rollout in US; energy storage targets established for IOUs Distribution Resource Plans and annual Smart Grid Plans required; 1 <sup>st</sup> in Solar penetration
Illinois	Y	Y	7%	\$21M	Y	Y	Utility investments resulting from the Implementation of Energy Infrastructure and Modernization Act are having a visible impact on the modernization of the state’s grid.
Pennsylvania	Y	Y	35%	\$482M	Y	Y	Act 129 of 2008 – calls for utilities with more than 100k customers to have smart meters and established Energy Efficiency and Conservation Plans
Maryland	Y	Y	63%	\$665M	Y	Y	ARRA grants focused on AMI and distribution automation (DA)
Delaware	Y	N	69%	\$0	Y	Y	State’s progressive approach in supported utility investments has resulted in investments in AMI and grid automation.
Nevada	Y	Y	99%	\$277M	N	N	NV Energy has 95% of state customers. The NV versus state policy and regulatory requirements is driving investments in the modernization of the electric grid. .
District of Columbia	Y	N	95%	\$92M	Y	Y	Retail and wholesale deregulation along with the demand for increasing levels of reliability has impacted the investments made by utilities in the district.
Arizona	Y	Y	71%	\$189M	N	N	Dynamic/TOU rates are available statewide 2 <sup>nd</sup> state in solar penetration

Virginia	V	N	11%	\$41M	Y	N	Highest score component is in Grid Operations. Analysis shows largest utility is driven investments in states. The utility is starting to migrate from AMR to AMI.
Idaho	N	N	66%	\$98M	N	N	ARRA grants focused on both AMI and DA Grid Operations score most significant component of overall score
Oklahoma	V	N	49%	\$293M	Y	N	ARRA grants have both AMI and DA focus 22% of customers have AMR meters
Michigan	Y	Y	33%	\$206M	Y	Y	ARRA grant focused on both AMI and DA Released 2012 Smart Grid Collaborative Report that frames statewide collaborative approach

Table 1: 2014 GMI Leading States Common Factors

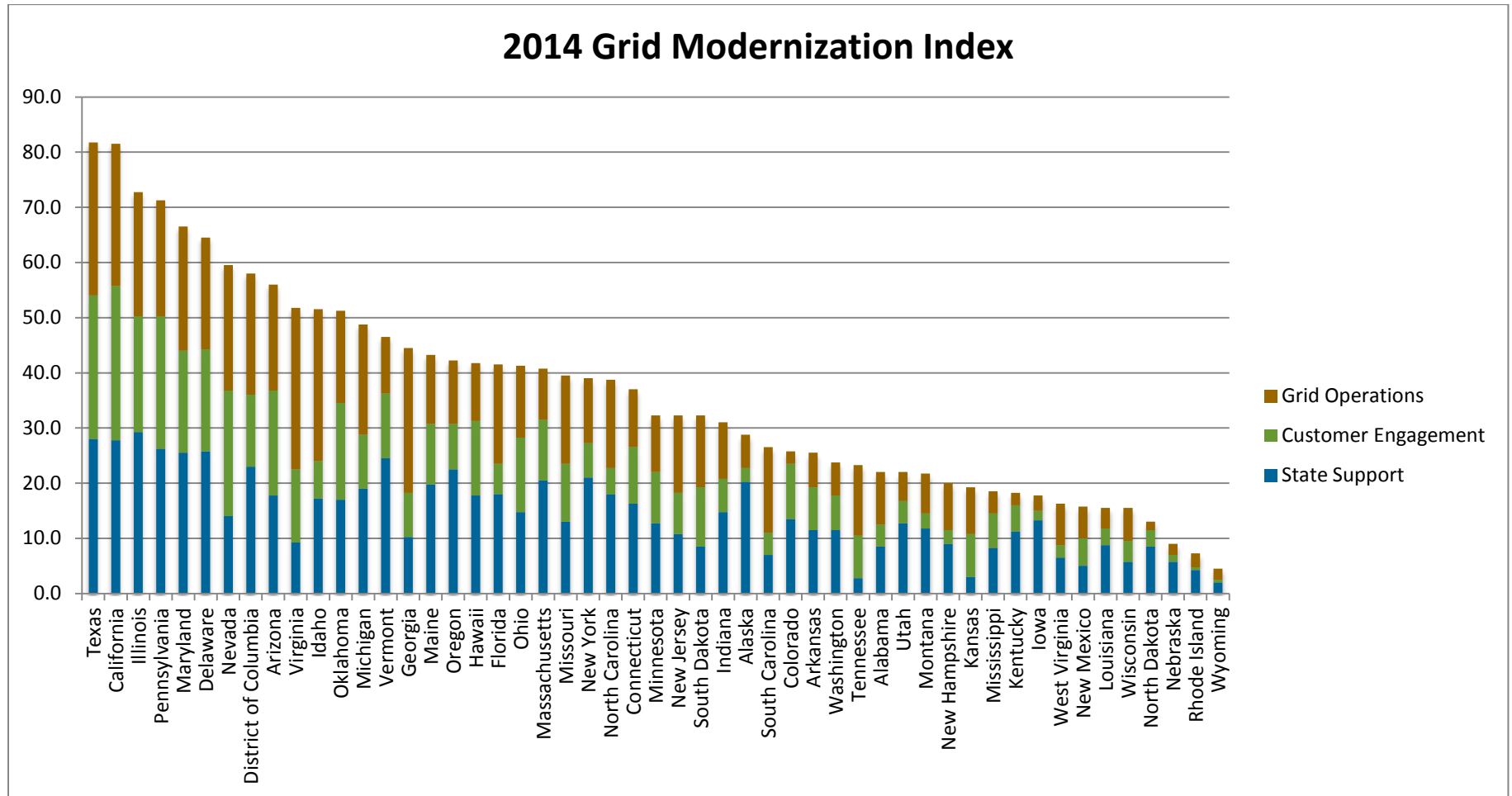


Figure 2 – 2014 GMI Rankings

## 2014 GMI Key Findings:

In reviewing the data and Accenture's statistical analysis, the following relationships were observed:

- State policies makes a difference
  - State energy policies not directly implemented for Grid Modernization purposes, lead to, or reflect, higher GMI scores in all categories, in any event.
  - These state policies include:
    - Mandatory Renewable Portfolio Standards (RPS);
    - Energy Efficiency Resource Standards (EERS);
    - Retail Deregulation;
    - Wholesale Deregulation;
    - Participation in Independent System Operator (ISO)/Regional Transmission Operator (RTO) Markets; and,
    - Mass Market Demand Response Programs.
- The states that received federal Smart Grid Investment Grants have higher GMI scores, with the impacts reflected most substantially in the Grid Operations component.
- Federal Smart Grid Workforce Grants did not appear to lead to a reflected change in GMI scores.
- Retail electricity rates showed no correlation with higher or lower GMI scores.
- The Northeast region has the highest average overall GMI score, followed by the Western Region, then Central Region and, finally, the Southeastern Region.
- States with 50 percent or higher penetration of Advanced Metering Infrastructure (AMI) demonstrate higher average scores in all three scoring categories.
- States with 50 percent or greater penetration of Automated Metering Reading (AMR) generally have higher Customer Engagement and Grid Operations scores.
- States that have a higher Gross Domestic Product (GDP) tend to have higher Customer Engagement, as well as overall, GM, scores.
  - Of the 15 states with above average GDP, 13 (87%) have above average GMI scores.
  - Of the 36 states with below average GDP, 24 (67%) have below average GMI scores.

## KEY DEVELOPMENTS

This year has been active with respect to emerging grid modernization state policies and activities. Some of the major state activities worth noting include:

- California's efforts to address emerging issues associated with increasing penetrations of both central and distributed renewable generation. These efforts include:
  - Energy storage mandates for 1,325 MW to be procured by the State's three major investor-owned utilities (IOUs).
  - Distribution Resources Plans – A new California law requires all IOUs in the State to submit a distribution resources plan by July 1, 2015. The plans must identify optimal locations for the deployment of DERs to meet electric system requirements.

- California IOUs continue to submit annual smart grid plans, and the California state agencies and its ISO are actively involved in developing and implementing plans to increase the penetration of demand response, energy efficiency, and other clean energy resources.
- Texas continues to lead in the implementation of deregulated retail services and effectively integrating large-scale wind generation, with the incorporation of large-scale energy storage. ERCOT has an effort underway to “rethink” the entire existing set of ancillary services.
- Illinois’ 2014 ranking increased by 13 points, since 2013, clearly reflecting the implementation of its “Energy Infrastructure and Modernization Act” passed in October 2011.
  - 2014 is the third year for ComEd and Ameren to execute on their approved Electric Infrastructure Investment Plans.
- Massachusetts deserves special recognition for having created a Commonwealth-wide Grid Modernization Plan.
  - It establishes a platform and incentives for utilities to modernize their electric infrastructure with four key objectives: 1) reducing the effects of outages; 2) optimizing demand, including reducing system and customer costs; 3) integrating distributed resources; and, 4) improving workforce and asset management.
  - The Department of Public Utilities (DPU) proposes two options for customers, in terms of considering time-varying rates as a basic service offering by utilities: 1) a time-varying rate as the basic rate for all consumers, unless they opt out of this plan; 2) a flat rate with a peak time rebate component.
  - Both of these options show significant leadership on the part of the DPU to advance the modernization of Massachusetts’ electric grid.
- In April 2014, New York’s Public Service Commission opened a proceeding entitled, “Reforming the Energy Vision” (REV). This effort could have significant impacts, not only in New York, but also across the country, as it establishes a new regulatory paradigm to align electric utilities’ practices with technological advances in information technology, power generation technologies, and grid operations technologies to achieve greater system efficiencies, greater penetration of clean generation and energy efficiency technologies, as well as greater customer control and choice over how they meet their energy requirements. New York is examining and evaluating regulatory reforms that would be implemented to shape the roles and responsibilities of the regulated utilities and retail markets. The effort is proceeding on two tracks:
  - The first track is examining the role of distribution utilities in enabling market-based deployment of distributed energy resources to promote load management and greater system efficiency, including peak load reductions.
  - The second track is examining changes in current regulatory, tariff, and market designs, and incentive structures, to better align utility interests with achieving the Commission’s policy objectives.
- Hawaii’s Public Utilities Commission has been working to achieve the State’s energy goals. Increasing penetrations of rooftop solar has led to the need to focus on the modernization of the electric grid to be able to effectively integrate and utilize these distributed energy resources. The State is focusing on:
  - Integrated Resource Planning – to incorporate higher penetrations of DERs;
  - Reliability Standards for integrating higher penetrations of DERs;

- Demand Response - increasing the value of these programs to both customers and utilities; and,
- Development of a System Improvement and Curtailment Reduction plan for Maui Electric.

Overall, there is an increasing focus at the state level on DERs both to enhance grid resiliency, particularly in the Northeast, where Hurricane Sandy had such a devastating impact, and to more effectively integrate increasing penetration levels, particularly of rooftop PV. There is increasing recognition at the state level that in order to effectively integrate higher levels of DERs, the grid will have to be modernized.

Many industry experts believe that it will take a minimum of six years to implement the distribution grid control systems needed to effectively manage significant penetration of DERs. However, as the commissions from several of the states who are managing increasing penetrations of rooftop photovoltaics (PV) can attest, with the right state policies incenting the deployment of these PV resources, it does not take six years to achieve penetration levels that need to be controlled and managed to prevent impacts to system reliability. The GMI is demonstrating this linkage through the correlation between state energy policies regarding generation and investments in modernizing the grid as an enabling platform.



## STATISTICAL ANALYSIS

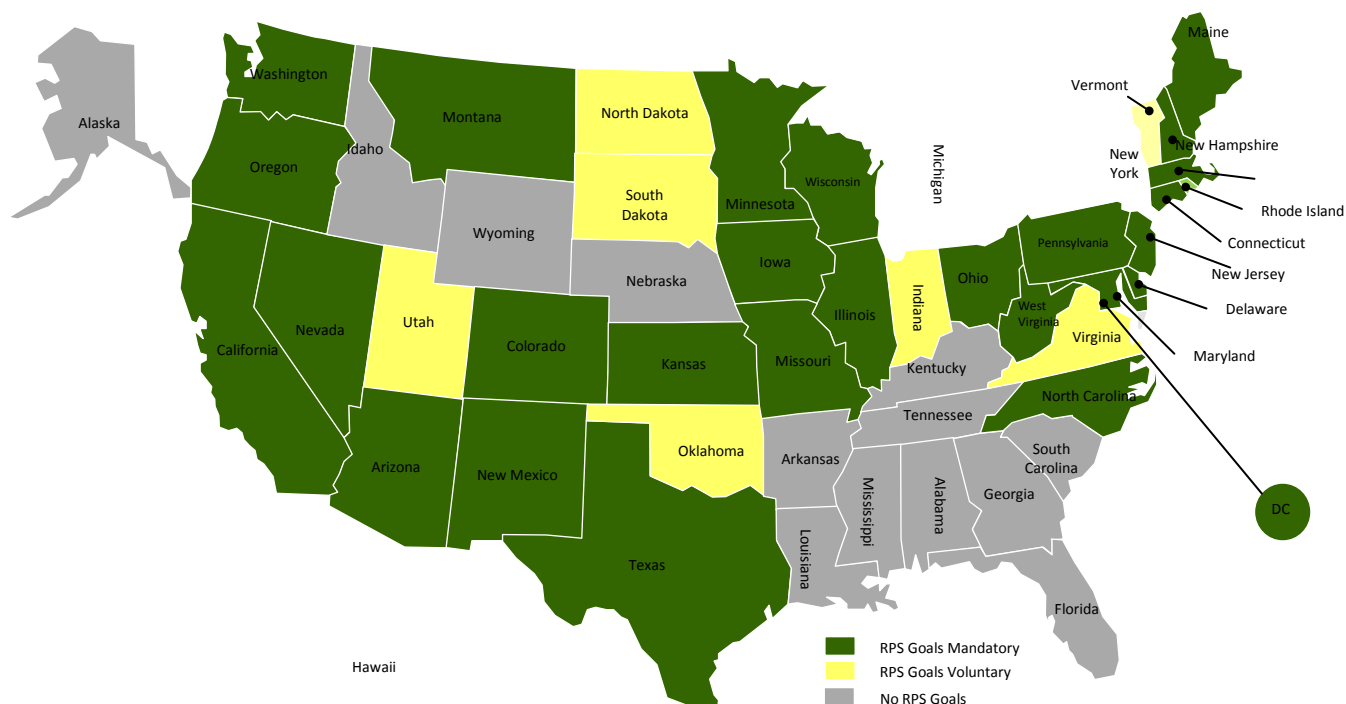
To identify drivers of investment, Accenture has performed a detailed analysis to identify statistically relevant relationships between GMI scores and key factors. This analysis compared the scores to the existence within the states of key factors. The analysis compares these key factors at the state and/or regional levels, or across a group of states with the same characteristic, such as participation in an ISO/RTO market. Key insights from this analysis include the following:

- State policies makes a difference
  - Energy policies not directly targeted at Grid Modernization show a statistically significant correlation to higher GMI scores in all categories
  - These state policies include:
    - Mandatory Renewable Portfolio Standards (RPS)
    - Energy Efficiency Resource Standards (EERS)
    - Retail Deregulation
    - Wholesale Deregulations
    - ISO/RTO markets
    - Mass Market Demand Response Programs
- States with Mandatory RPS Goals have strong positive statistical correlations in the three component scores. States with voluntary or no RPS Goals do not show this same correlation.
- States with an EERS in place have strong correlation of State Support, Customer Engagement, and Grid Operations.
- States with Retail and Wholesale DR Programs show a very high positive correlation between State Support, Customer Engagement, Grid Operations, and overall GMI Scores.
- Retail Electricity Price has no correlation with State Support, Customer Engagement, and Grid Operations.
- States with current revenue decoupling mechanisms did not demonstrate a statistical correlation with their GMI scores. GWA and SGPC recognize that revenue decoupling is an important policy in achieving EERS objectives as well as an emerging concept for transitioning the grid and grid operator from being a commodity delivery infrastructure to a services provider and enabling infrastructure.

The following section details this analysis and highlights the results.

## Renewable Portfolio Standards:

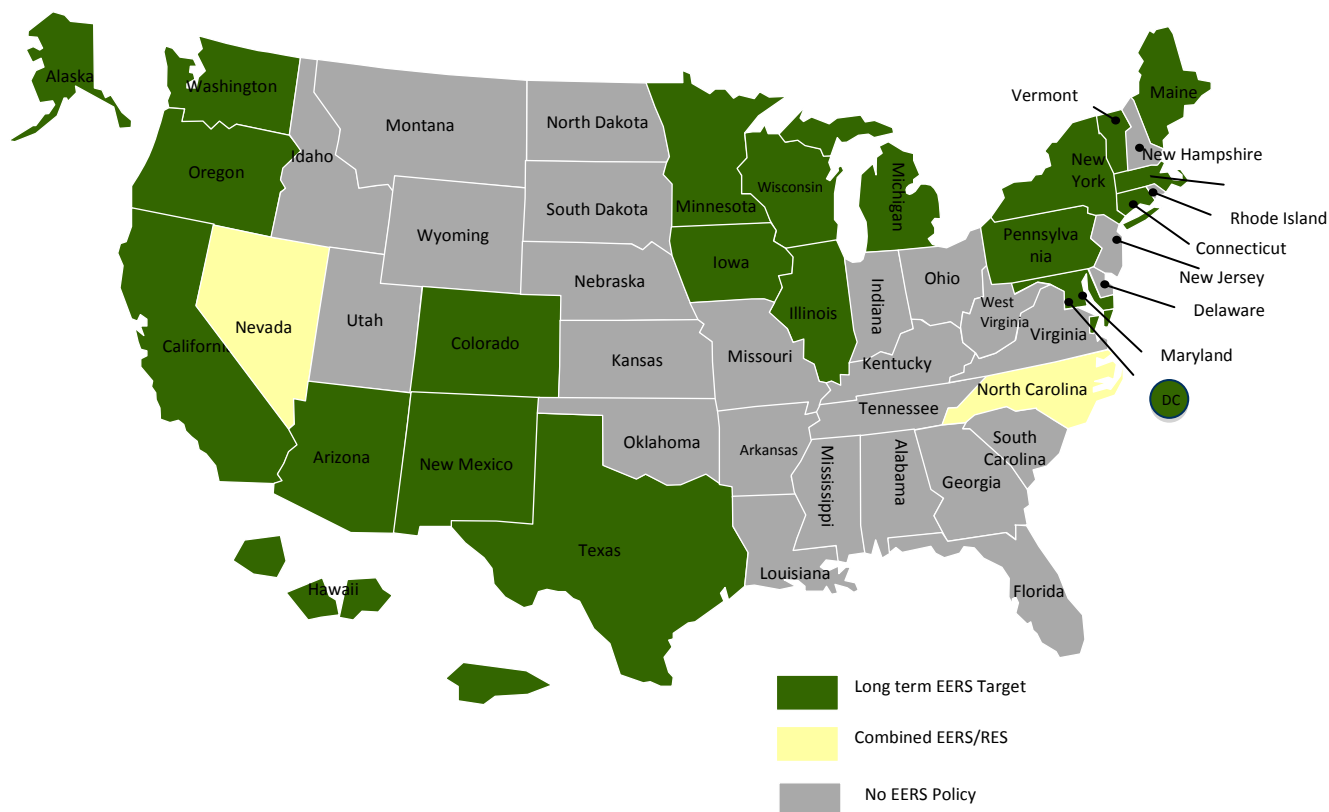
- States with mandatory renewable portfolio standards have strong positive correlation in between the three factors.
- The correlation weakens for the states with voluntary goals.



RPS Goals Mandatory	State Support	Customer Engagement	Grid Operations	Total Score
<b>Average Score</b>	<b>16.38</b>	<b>11.28</b>	<b>13.42</b>	<b>41.12</b>
<b>Std. Deviation</b>	<b>7.52</b>	<b>7.56</b>	<b>7.25</b>	<b>20.84</b>
RPS Goals Voluntary	State Support	Customer Engagement	Grid Operations	Total Score
<b>Average Score</b>	<b>13.68</b>	<b>9.51</b>	<b>12.32</b>	<b>35.42</b>
<b>Std. Deviation</b>	<b>5.75</b>	<b>5.42</b>	<b>8.97</b>	<b>15.08</b>
No RPS Goals	State Support	Customer Engagement	Grid Operations	Total Score
<b>Average Score</b>	<b>10.35</b>	<b>4.85</b>	<b>10.64</b>	<b>25.9</b>
<b>Std. Deviation</b>	<b>5.6</b>	<b>2.5</b>	<b>9.35</b>	<b>14.30</b>

### Energy Efficiency Resource Standards:

- States with an EERS in place have higher average scores for State Support, Customer Engagement and Grid Operations.
- The 24 states with an EERS in place have high positive correlation between State Support, Customer Engagement and Grid Operations.

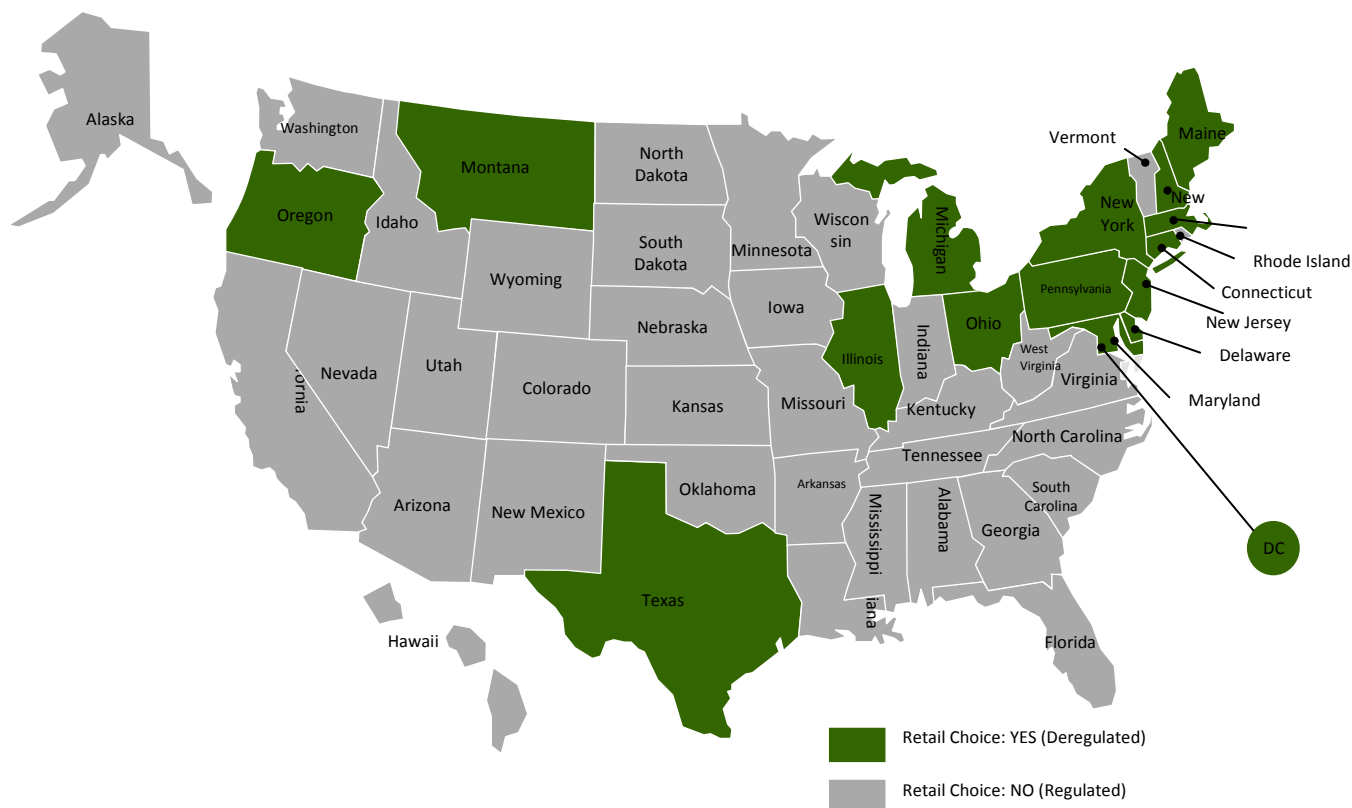


EERS Targets	State Support	Customer Engagement	Grid Operations	Total Score
<b>Average Score</b>	<b>18.57</b>	<b>12.61</b>	<b>13.96</b>	<b>45.25</b>
<b>Std. Deviation</b>	<b>6.54</b>	<b>7.28</b>	<b>7.47</b>	<b>19.51</b>
No EERS Policy	State Support	Customer Engagement	Grid Operations	Total Score
<b>Average Score</b>	<b>10.83</b>	<b>6.55</b>	<b>11.32</b>	<b>28.67</b>
<b>Std. Deviation</b>	<b>5.53</b>	<b>4.73</b>	<b>8.06</b>	<b>15.34</b>

## Retail Deregulation:

Deregulated States have higher average scores across all the three components of State Support, Customer Engagement and Grid Operations

- **76% of the deregulated states are leading on overall GMI scores**
- **35% of the regulated states are leading on overall GMI scores**



Retail Choice States	State Support	Customer Engagement	Grid Operations	Total Score
<b>Average Score</b>	<b>19.26</b>	<b>12.09</b>	<b>15.10</b>	<b>46.41</b>
<b>Std. Deviation</b>	<b>7.23</b>	<b>7.39</b>	<b>6.89</b>	<b>20.57</b>
Regulated States	State Support	Customer Engagement	Grid Operations	Total Score
<b>Average Score</b>	<b>12.08</b>	<b>8.06</b>	<b>11.29</b>	<b>31.5</b>
<b>Std. Deviation</b>	<b>6.01</b>	<b>6.25</b>	<b>8.27</b>	<b>17.13</b>

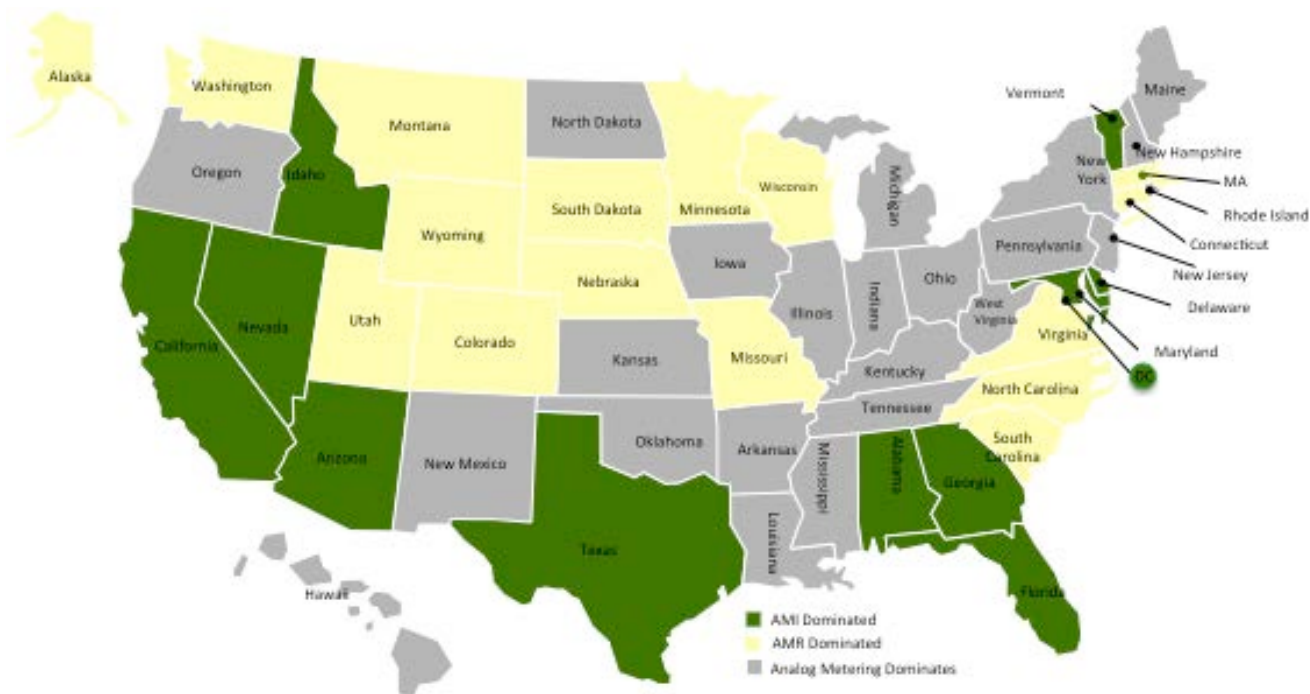




- All of the 42 States that received federal Smart Grid Investment Grants (SGIG) funding had high positive correlation with the Grid Operations component of the survey. They had low positive correlations to State Support and Customer Engagement scores.
- The 33 States that received funding from the federal Smart Grid Workforce Grants show no statistical correlation with State Support, Customer Engagement and Grid Operations component scores.

### AMI and AMR Dominated States:

- The 12 states that are AMI Dominant (50% or greater AMI meters) have high positive correlation in between State Support, Customer Engagement and Grid Operations.
- The 16 states that are AMR Dominant (50% or greater AMR meters) have positive correlation in between Customer Engagement and Grid Operations.

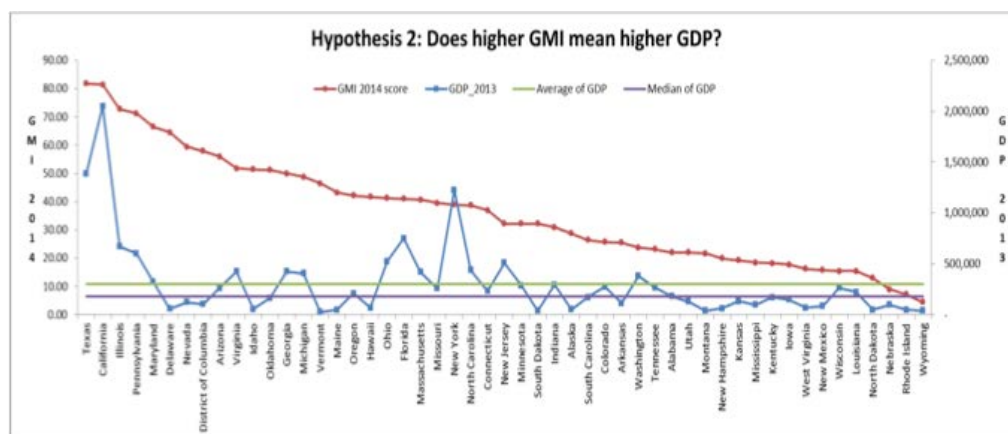
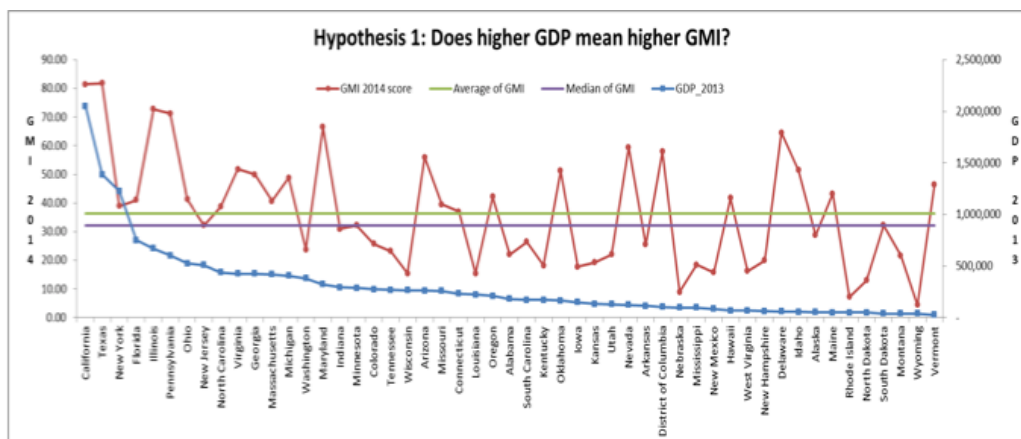


AMI Dominated	State Support	Customer Engagement	Grid Operations	Total Score
Average Score	20.28	15.19	21.19	55.17
Std. Deviation	6.15	7.76	6.04	23.41
AMR Dominated	State Support	Customer Engagement	Grid Operations	Total Score
Average Score	11.55	5.94	9.13	20.13
Std. Deviation	5.41	3.95	7.00	15.88



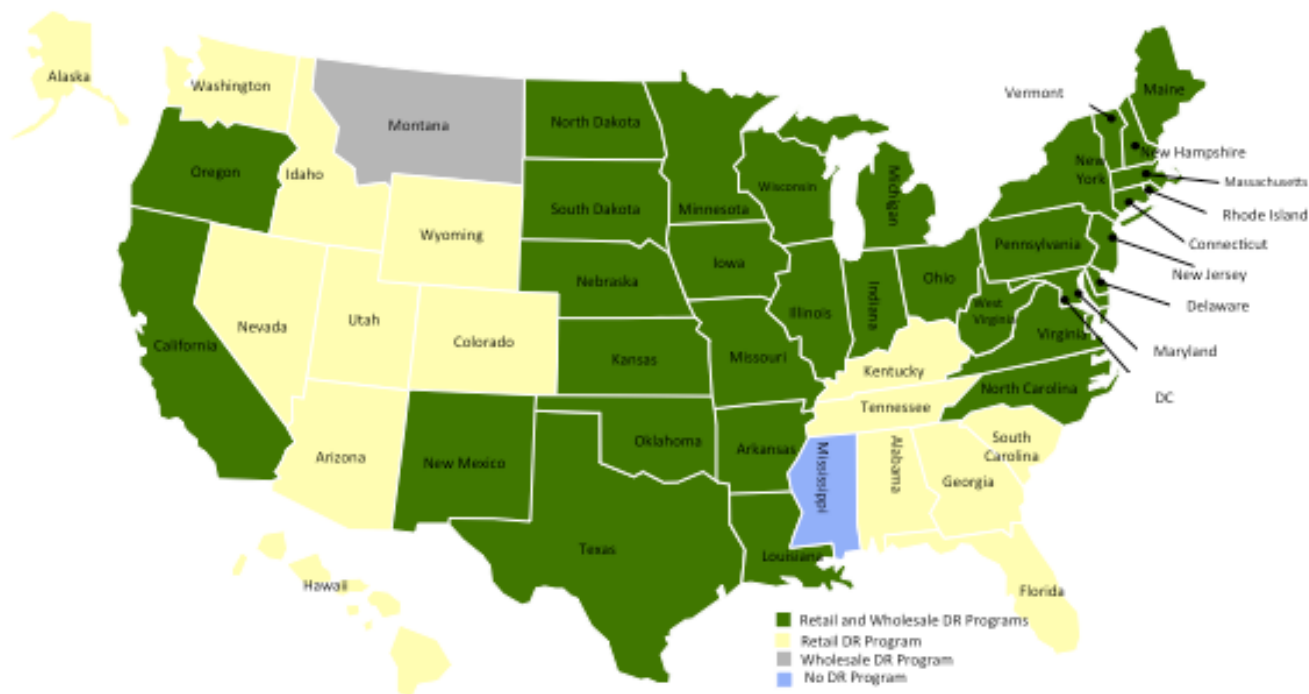
## State GDP:

- States with higher GDP have high correlations with Customer Engagement and overall GMI scores.
  - Of the 15 states with above average GDP, 13 states (87%) have above average GMI scores
  - Of the 36 states with below average GDP, 24 states (67%) have below average GMI scores
  - Of the 25 states with an above average GMI score, 13 states (52%) have above average GDP
  - Of the 26 states with below average GMI scores, 24 states (92%) have below average GDP



## Regional Analysis:

- The Northeast Region has the highest average scores for all components across all regions.
- The Western and Central Regions show positive correlations between all three components of the survey
- The Southeast Region shows no statistical correlations among any of the components.



Northeast Region	State Support	Customer Engagement	Grid Operations	Total Score
Average Score	17.14	10.97	14.32	42.4
Std. Deviation	7.63	6.39	7.16	18.70
Western Region	State Support	Customer Engagement	Grid Operations	Total Score
Average Score	14.21	10.31	12.30	37
Std. Deviation	7.24	8.93	9.67	23.17

Central Region	State Support	Customer Engagement	Grid Operations	Total Score
Average Score	<b>13.79</b>	<b>9.91</b>	<b>12.10</b>	<b>35.77</b>
Std. Deviation	<b>8.04</b>	<b>7.61</b>	<b>8.23</b>	<b>22.77</b>
Southeast Region	State Support	Customer Engagement	Grid Operations	Total Score
Average Score	<b>10.73</b>	<b>5.63</b>	<b>11.68</b>	<b>28.1</b>
Std. Deviation	<b>4.71</b>	<b>1.79</b>	<b>8.24</b>	<b>11.38</b>

### Retail Electricity Rates:

- Retail electricity rates has no statistical correlation to scoring in any of the three component areas; however, the analysis was done based on EIA rate data which is the average rate per kwh and does not factor in tiered usage rates.

Customer Class	State Support	Customer Engagement	Grid Operations
Commercial & Residential 2013 State Average Rate	Low Positive Correlation <0.50	Low Positive Correlation <0.50	Low Positive Correlation <0.50
Commercial 2013 State Average Rate	Low Positive Correlation <0.50	Low Positive Correlation <0.50	Low Negative Correlation <0 and >-0.5
Residential 2013 State Average Rate	Low Positive Correlation <0.50	Low Positive Correlation <0.50	Low Positive Correlation <0.50
Commercial + Residential 2014 State Average Rate	Low Positive Correlation <0.50	Low Positive Correlation <0.50	Low Negative Correlation <0 and >-0.5
Commercial 2014 State Average Rate	Low Positive Correlation <0.50	Low Positive Correlation <0.50	Low Negative Correlation <0 and >-0.5
Residential 2014 State Average Rate	Low Positive Correlation <0.50	Low Positive Correlation <0.50	Low Negative Correlation <0 and >-0.5

## APPENDIX A: SURVEY QUESTIONS

### Methodology

The GMI ranking system, or “scorecard,” uses a clearly defined set of criteria to evaluate and convey the progress and impacts of this transformative set of improvements to the nation’s electric infrastructure. This Grid Modernization Index consists of three components:

1. **State Support:** State policies and regulatory mechanisms that facilitate grid investment;
2. **Customer Engagement:** Investments throughout the state in customer-enabling technologies and capabilities; and,
3. **Grid Operations:** Investments throughout the state in grid-enhancement technologies and capabilities.

For full credit, 60% of consumers in state must have the capability or function.

### State Support

The state policies and regulatory “enablers” component of the Index is composed of the following elements:

- Does the state have a grid modernization strategy, policy, or requirement that electric service providers (ESPs) in the state develop and submit a plan?
- Does the state have an Energy Sustainability, Environmental Plan or similar plan that includes its strategy for clean energy supply (including an Energy Efficiency Resource Standard (EERS) or Goal) and/or Renewable Portfolio Standard or Goal?
- Do the state or ESPs have or does the utility commission require ESPs to have a security/cyber-security plan for:
  - Electric delivery; and/or
  - Customer energy data?
- Does the state have, or review and approve, ESPs customer energy usage data privacy policies?
- Does the state have a formal plan to educate customers and/or conduct outreach on grid modernization, and does it allow ESPs to recover costs of implementation?
- Are metrics being reported publicly to legislators, regulators, or other state officials to track the progress of grid modernization progress?
- Are distributed energy resources such as photovoltaic (PV) solar systems, electric vehicles, energy storage, wind, fuel cells, etc. incented by state funds or supported in legislature or rulemakings? (Credit given for up to types of resources with electric vehicles (EVs) and Energy Storage having to be two of the resources included.)
- Has the state established clear mechanisms for project approval and cost recovery of grid modernization projects?
- Is the utility industry workforce, including that of commissions, system operators, and utilities, changing to meet the needs of a modernized grid?

- Is the state measuring the value of modernizing grid operations (i.e., has the state adopted or identified a cost-effectiveness/performance methodology for grid investments, including reliability, security/resiliency, utility, customer cost, and environmental impacts)?

## Customer Engagement

The customer engagement component of the GMI is composed of the following elements:

- Does the state have dynamic pricing plans or rates that leverage smart grid technologies for mass market customers, including the following:
  - Residential time-of-use or time-of-day rates;
  - Small commercial time-of-use or time-of-day rates;
  - Residential critical peak pricing;
  - Small commercial critical peak pricing;
  - Residential demand response;
  - Small commercial demand response;
  - Real-time, market-based pricing; and/or,
  - A price for reactive energy for mass-market customers?
- Are pricing events, such as demand response, critical peak pricing, or peak time rebates, communicated to customers via one or more personalized methods, such as:
  - Electronic mail;
  - Mobile text message;
  - Outbound dialer;
  - Twitter; and/or,
  - Other?
- Are there a tariff and/or incentive for integrating the grid with new technologies such as EVs, energy storage, PV, wind and/or fuel cells, customer-side microgrids, etc. supported by ESPs? Credit is give for up to four types, but EVs and energy storage must be one of the technologies supported by tariffs or incentives.
- Is there a platform that allows customers to obtain their own "interval" daily energy usage information and/or automate communication of daily usage information to third parties with privacy provisions?
  - Is there a platform (e.g., "Green Button") that enables customers to obtain data?
  - Is this platform a standard?
  - Is there a platform (e.g. "Green Button Connect") that enables third party automatic access?
  - Is this platform a standard?
- Is customer education/outreach on grid modernization being implemented successfully?
- Are software analytics being used to segment, understand, and communicate with customers?

## Grid Operations

The grid operations component of the GMI considers and analyzes whether ESPs in the state are implementing and leveraging technologies to deliver the benefits of a modernized electric grid, and is comprised of the following technologies and capabilities::

- Metering Systems Deployed:
  - Automated Meter Reading (AMR)
  - Advanced Metering Infrastructure (AMI)
- Deployment of advanced, communicating transmission sensors. Credit for up to 3 types of sensors, such as:
  - Phasor Measurement Units (PMUs)
  - Dynamic line rating
  - Fault indicators
  - Transformer monitoring
- Deployment of advanced, communicating distribution sensors. Credit for up to 4 types of sensors, such as:
  - Phasor Measurement Units (PMUs)
  - Dynamic line rating
  - Fault indicators
  - Transformer monitoring (beyond T-D substations)
- Is energy storage deployed and leveraged as a tool for system planning? Examples - postpone or eliminate capacity additions of any kind, providing ancillary services such as spinning reserves, frequency support, voltage support, etc.
- Are microgrids implemented and being leveraged via price-responsive and/or for ride-through (voltage and/or frequency) capable?
- Has AMI been integrated with other utility systems to increase benefits, such as outage detection, remote connect/disconnect, tamper detection, power quality monitoring, and more (credit for up to 3 integration benefits)?
- Has distributed automation (DA) been deployed at:
  - Substations;
  - Line switches;
  - Circuit ties?
- Has Distribution Management System (DMS) functionality been integrated with sensor data, capacitor bank monitoring and/or control, voltage regulator monitoring and/or control, or storage charge and/or discharge (credit given for up to 3 functions)?
- Probabilistic planning– based on new data from equipment and sensors – is being utilized in distribution, transmission, or customer interactions and/or across the enterprise for increased system value (credit given for each one of these functional areas)?

- “Self-healing” (i.e., to autonomously operate and/or reconfigure) capability is deployed?
- Advanced Geographical Information System (GIS) capabilities and functionality are deployed? (Advanced defined as digitized, geospatial representation of system that models connectivity and phasing, and incorporates new assets such as AMI and sensors)
- GIS is integrated with Asset Management (AM)? (Defined as detail data on assets stored in AMS and can be accessed through GIS system in dispatch centers or in the field)
- Advanced visualization tools are being used? (Defined as – control center personnel can visually see a schematic representation of grid conditions and field resources to assess and respond to real time situations)

To ensure consistency of interpretation and scoring, the GridWise Alliance established a GMI project team, comprised of several of its members to research the progress of grid modernization in each state. The team used publicly available documents and conducted interviews with key stakeholders, including public service commissions and utilities. Leveraging this information, the project team scored and ranked each state, according to the criteria or questions in each category highlighted at the outset (i.e., policy, consumer engagement, grid operations). On September 3 -4, 2014, a face to face “Challenge session” was held to improve the consistency in ratings across the various states.



## APPENDIX B: AVERAGES FOR QUARTILE RANKINGS

Top Quartile				
<i>California, Texas, Illinois, Pennsylvania, Maryland, Delaware, Nevada, District of Columbia, Arizona, Virginia, Idaho, Oklahoma, Michigan</i>				
4 <sup>th</sup> Quartile	State Support	Customer Engagement	Grid Operations	Total Score
Average Score	21.5	18.3	22.9	62.7
Median Score	23.0	18.5	22.5	59.5
Std. Deviation	6.0	6.0	3.6	10.9
2 <sup>nd</sup> & 3rd Quartiles				
<i>Georgia, Vermont, Maine, Oregon, Hawaii, Massachusetts, Ohio, Florida, New York, Missouri, North Carolina, Connecticut, Minnesota, New Jersey, South Dakota, Indiana, Alaska, Colorado, Arkansas, South Carolina, Washington, Utah, Montana, Tennessee, Alabama</i>				
2 <sup>nd</sup> & 3rd Quartiles	State Support	Customer Engagement	Grid Operations	Total Score
Average Score	14.5	7.9	11.4	33.7
Median Score	13.5	7.8	10.5	32.3
Std. Deviation	5.2	3.2	4.8	8.1
4 <sup>th</sup> Quartile				
<i>New Hampshire, Kansas, Mississippi, Kentucky, Iowa, West Virginia, New Mexico, Louisiana, Wisconsin, North Dakota, Nebraska, Rhode Island, Wyoming</i>				
4 <sup>th</sup> Quartile	State Support	Customer Engagement	Grid Operations	Total Score
Average Score	7.0	3.3	4.4	14.7
Median Score	6.5	3.0	3.8	15.8
Std. Deviation	3.1	2.1	2.5	4.7

## APPENDIX C: ADVISORY COMMITTEE MEMBERS

GWA and SGPC also established a distinguished Advisory Committee made up of key stakeholders and influencers, including; state commissioners, commission staff, Federal Energy Regulatory Commission (FERC), Department of Energy (DOE), other non-profit organizations representatives, national lab representative, both transmission and distribution utility representatives, and equipment provider representative. This Advisory Committee provided valuable input into the criteria, evaluation and analysis, which greatly enhanced the value of the GMI.

- Angela Becker-Dippmann (Senior Policy Advisor, PNNL)
- Nicolas Chaset (Advisor to CPUC Commissioner Picker, California PUC)
- Michael Champley (Commissioner, Hawaii PUC)
- Lisa Edgar (Commissioner, Florida PSC)
- Craig Glazer (Vice President Federal Government Policy, PJM)
- Philip Jones (Commissioner, Washington UTC)
- Travis Kavulla (Commissioner, Montana PUC)
- Hank Kenchington (Deputy Assistant Secretary for R&D, DOE OE)
- Peter Klauer (Smart Grid Solutions Manager, CAISO)
- Lee Krevat (Smart Grid Director, SDG&E)
- Audrey Lee (Advisor to CPUC President Peevey, California PUC)
- Mark McGranaghan (Vice President of Power Delivery & Utilization, EPRI)
- John Norris (Former Commissioner, FERC)
- Gary Rackliffe (Vice President Smart Grids, ABB)
- Phyllis Reha (Commissioner Emeritus, Minnesota PUC )
- Ronny Sandoval (Project Engineer – US Climate and Energy, EDF)
- Kelly Speakes-Backman (Commissioner, Maryland PSC)
- Rudy Stegemoeller (Special Assistant for Energy Policy, New York PSC)
- Paul Zummo (Manager of Policy Research & Analysis, APPA)

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